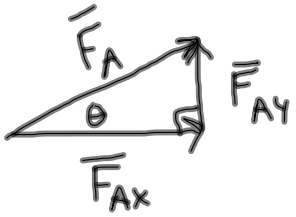
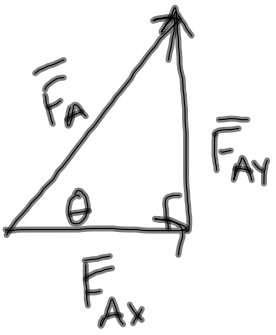
Pulling or Pushing at an angle:

- Pulling/pushing horizontally requires the least amount of force
- As the angle increases, the total amount of force also increases
- The force in x-direction stays the same, but the force in the y-direction increases.

$\longrightarrow \vec{F}_{Ax} = \vec{F}_A$



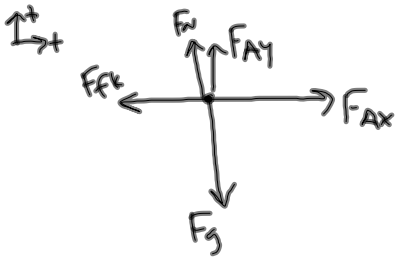


A person pulls a box (mass = 20 kg) with a force of 75 N at 30°. The box is on a surface that has a coefficient of friction (μ_k) of 0.33. What is the acceleration of the box in the x-direction?

$F_{Ax} = F\cos(30°)$
$= 64.95\ N$

$F_{Ay} = F\sin(30°)$
$= 37.5\ N$

FBD:



$$\sum F_x = m\bar{a}_x$$

$$a_x = \frac{\sum F}{m} = \frac{F_{Ax} - F_{fk}}{m} = \frac{64.95\ N - 52.3\ N}{20\ kg}$$
$$= 0.63\ m/s^2$$

$F_{fk} = \mu_k F_N$
$= (.33)(158.5\ N)$
$= 52.3\ N$

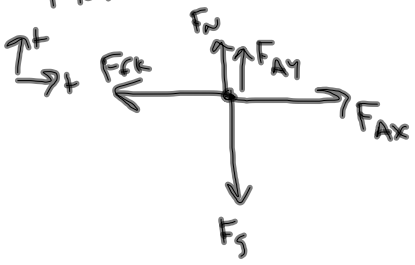
$\sum F_y = ma_y^{\nearrow 0}$

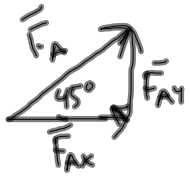
$F_N + F_{Ay} - F_g = 0$

$F_N = F_g - F_{Ay}$
$= ma_g - F_{Ay}$
$= (20\ kg)(9.8\ m/s^2) - 37.5\ N$
$= 158.5\ N$

A box is pulled at a constant velocity and the box has a mass of 10 kg. If the person pulls with a force of 20 N at 45°, what is the coefficient of kinetic friction between the box and the floor?

FBD:





$\bar{F}_{AX} = \bar{F}_{AY} = 14.14\ N$

$F_{fk} = \mu_k F_N$

$\mu_k = \frac{F_{fk}}{F_N}$

$= \frac{14.14\ N}{83.86\ N}$

$= 0.168$

$\sum F_x = ma_x = \emptyset$

$F_{Ax} - F_{fk} = \emptyset$

$F_{fk} = F_{Ax}$

$= 14.14\ N$

$\sum \bar{F}_y = \emptyset$

$F_N + F_{AY} - F_g = \emptyset$

$F_N = F_g - F_{AY}$

$= mg - F_{AY}$

$= (10\ kg)(9.8\ m/s^2) - 14.14\ N$

$= 83.86\ N$